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EXAMINER	
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)
	09/765,014	AGAZZI, OSCAR E.
	Examiner	Art Unit
	David S. Kim	2613

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *12 June 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *See Continuation Sheet* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,5-9,11,12,16,18-20,22,23,28,31,32,36-38,41,42,45,57,60,61,64,65,69-71 and 74* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

Continuation of Disposition of Claims: Claims pending in the application are 1,5-9,11,12,16,18-20,22,23,28,31,32,36-38,41,42,45,57,60,61,64,65,69-71 and 74.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. **Claims 1, 6-9, 11-12, 18-20, 22-23, 28, 32, 37-38, 42, 57, 61, 65, and 70-71** are rejected under 35 U.S.C. 103(a) as being unpatentable over Ling et al. (International Application No. WO 98/39871, hereinafter "Ling") in view of any/all of Ungerboeck ("Channel coding with multilevel/phase signals"), Lee (*Convolutional Coding: Fundamentals and Applications*), and Schlegl (*Trellis Coding*) and further in view of Uyematsu et al. ("Trellis coded modulation for multilevel photon communication systems," hereinafter "Uyematsu"), and Winters et al. ("Reducing the effects of transmission impairments in digital fiber optic systems", hereinafter "Winters").

Regarding claim 1, Ling discloses:

A method for high-speed transmission of information data on a channel, the method comprising:

encoding (Fig. 3, portion before DAC 326) information via a trellis encoder to produce digital multilevel symbols;

equalizing the digital multilevel symbols to compensate for characteristics of the channel (p. 3, l. 17-28), said equalizing comprising precoding the digital multilevel symbols using a Tomlinson Harashima precoder (Tomlinson/Harashima precoding 324);

converting (DAC 326) the digital multilevel symbols into analog multilevel symbols; and

transmitting the analog multilevel signals (output of DAC 326) over the channel.

Ling does not expressly disclose:

said channel being an *optical* channel.

However, the method of Ling appears to be a trellis coded modulation (TCM) scheme (implied by trellis decoder 366 in Fig. 3 of Ling), and Uyematsu teaches that applying TCM to optical communication systems is known in the art (Uyematsu, p. 582, col. 1, last paragraph). The only portion of a TCM system that appears lacking in the system of Ling is an express disclosure of a trellis encoder. However, it is known that trellis encoding incorporates convolutional encoding and mapping, as shown in Ungerboeck (p. 58, Fig. 3), Lee (p. 159, Figure 7.11), and Schlegl (p. 44, Fig. 3.1 shows a trellis encoder; p. 91 and Fig. 4.1 show that the FSM in Fig. 3.1 is a convolutional encoder). Fig. 3 of Ling shows basic elements of a trellis encoder: a convolutional encoder 320 and bit to symbol mapping 322. At the time the invention was made, it would have been obvious to one of ordinary skill in the art to employ Ling's convolutional encoder 320 and bit to symbol mapping 322 as a trellis encoder. One of ordinary skill in the art would have been motivated to do this since the trellis decoder 366 of Ling implies the complementary use of trellis encoding. As an additional motivation, trellis encoding provides an advantage over just convolutional encoding: preservation of bandwidth (Schlegl, p. 8).

Accordingly, the system of Ling in view of any/all of Ungerboeck, Lee, and Schlegl would constitute a TCM system. At the time the invention was made, it would have been obvious to a person of ordinary skill in the art to apply the TCM method of Ling in view of any/all of Ungerboeck, Lee, and Schlegl to an optical communication system to transmit the analog multilevel signals over an *optical* channel. One of ordinary skill in the art would have been motivated to do this since TCM is attractive in optical communication systems. That is, TCM can help relieve bandwidth limits imposed on an optical system by the optical system's electrical parts (Uyematsu, p. 582, col. 1, last paragraph). Also, it is well known that optical channels, such as optical fiber, offer benefits over other types of channels, such as electrical channels. Some well-known benefits of optical fiber are low loss and lower susceptibility to electromagnetic interference.

Additionally, the system of Ling in view of any/all of Ungerboeck, Lee, Schlegl, and further in view of Uyematsu does not expressly disclose:

equalizing the digital multilevel symbols to compensate for characteristics of the ***optical*** channel.

However, performing equalization in optical systems is well known in the art, as shown by Winters (Winters, e.g., p. 68, col. 1, 1st paragraph; equalization by transversal filters in Tables 1-3; at transmitting side on p. 72, col. 2, middle paragraph; at receiving side on p. 70). At the time the invention was made, it would have been obvious to one of ordinary skill in the art to employ the equalization techniques of Ling in the optical system of Ling in view of any/all of Ungerboeck, Lee, Schlegl, and Uyematsu. One of ordinary skill in the art would have been motivated to do this since equalization, which reduces inter-symbol interference (ISI), is effective in compensating for characteristics of an optical channel (Winters, p. 68, col. 2, last paragraph; equalization by transversal filters in Tables 1-3; at transmitting side on p. 72, col. 2, middle paragraph; at receiving side on p. 70), thus enabling one to significantly increase the data rate and/or reduce the effect of transmission impairments and improve performance in optical systems (Winters, p. 68, col. 1, 1st paragraph).

Regarding claim 6, Ling in view of any/all of Ungerboeck, Lee, and Schlegl and further in view of Uyematsu, and Winters discloses:

The method of claim 1 wherein the information that is encoded comprises input bits and wherein encoding the information includes mapping the input bits into digital multilevel symbols (bits to symbol mapping 322).

Regarding claim 7, Ling in view of any/all of Ungerboeck, Lee, and Schlegl and further in view of Uyematsu, and Winters discloses:

The method of claim 1 wherein transmitting the analog multilevel symbols over an optical channel comprises modulating the intensity of a light source according to the level of the analog multilevel symbols (Uyematsu, "intensity modulator," p. 582, middle of col. 2).

Regarding claim 8, Ling in view of any/all of Ungerboeck, Lee, and Schlegl and further in view of Uyematsu, and Winters discloses:

The method of claim 1 wherein transmitting the analog multilevel signals over an optical channel comprises modulating laser intensity according to a level of the analog multilevel signals (Uyematsu, "intensity modulator," p. 582, middle of col. 2).

Regarding claim 9, Ling in view of any/all of Ungerboeck, Lee, and Schlegl and further in view of Uyematsu, and Winters discloses:

A method as in claim 1 wherein equalizing the digital multilevel symbols to compensate for the laser and channel characteristics comprises:

characterizing the channel (i.e. channel responses on p. 2, l. 31-35); and

applying an inverse characterization of the channel to the digital multilevel symbols (i.e. filter coefficients on p. 3, l. 17-22).

Regarding claim 11, claim 11 is a method claim that corresponds largely to the method claim 1. Therefore, the recited steps in method claim 1 read on the corresponding steps in method claim 11. Claim 11 also includes limitations absent from claim 1. Ling in view of any/all of Ungerboeck, Lee, and Schlegl and further in view of Uyematsu, and Winters does not expressly disclose these limitations:

accepting information from a plurality of sources;

a *plurality of* trellis encoders, digital multilevel symbols, analog multilevel signals; and

transmitting the analog multilevel signal by time division multiplexing the plurality of analog multilevel signals onto an optical channel.

However, Examiner takes Official Notice that these "plurality" limitations are all part of an extremely well known practice of transmitting a time division multiplexed signal. At the time the invention was made, it would have been obvious to a person of ordinary skill in the art to implement these limitations in the method of Ling in view of any/all of Ungerboeck, Lee, and Schlegl and further in view of Uyematsu, and Winters. One of ordinary skill in the art would have been motivated to do this since transmitting a time division multiplexed signal is a common way to transmit multiple channels of data across a single optical communication line (fiber), thus increasing the number of users without requiring the installation of additional optical communication lines (fibers).

Regarding claims 12 and 18-20, claims 12, 18, 19, and 20 are method claims that correspond to method claims 6, 7, 8, and 9, respectively. Therefore, the recited steps in method claims 6-9 read on the corresponding steps in method claims 12 and 18-20.

Regarding claims 22-23, Examiner takes Official Notice that each of these claims discloses known ways to implement the extremely well known practice of transmitting a time division multiplexed signal. Claim 22 discloses a way using a *single* analog to digital converter. Claim 23 discloses a way using a *plurality* of digital to analog converters. At the time the invention was made, it would have been obvious to a person of ordinary skill in the art to implement these various ways in the method of Ling in view of any/all of Ungerboeck, Lee, and Schlegl and further in view of Uyematsu, and Winters. One of ordinary skill in the art would have been motivated to do this since each offers design flexibility for the system of Ling in view of any/all of Ungerboeck, Lee, and Schlegl and further in view of Uyematsu, and Winters.

Regarding claim 28, Ling in view of any/all of Ungerboeck, Lee, and Schlegl and further in view of Uyematsu, and Winters discloses:

A method of signaling over an optical channel, the method comprising:

accepting data from a source (reception of data in 310 in Fig. 3);

trellis encoding the data (Fig. 3, portion before DAC 326);

equalizing the data (Ling, Fig. 3, Tomlinson/Harashima precoding 324), said equalizing comprising precoding the data using a Tomlinson Harashima precoder;

coupling the equalized encoded data into an optical channel (Uyematsu, "intensity modulator," p. 582, middle of col. 2);

conveying the data over the optical channel;

accepting data from the optical channel (Uyematsu, "intensity modulator," p. 582, middle of col. 2);

decoding the data accepted from the optical channel (receiver 312); and

providing the decoded data to an interface (output of receiver 312).

Regarding claims 32 and 37, claims 32 and 37 are apparatus claims that correspond to method claims 1 and 8, respectively. Therefore, the recited steps in method claims 1, and 8 read on the corresponding means in apparatus claims 32 and 37. Claims 32 and 37 also include limitations absent

from claims 1 and 8. Ling in view of any/all of Ungerboeck, Lee, and Schlegl and further in view of Uyematsu, and Winters discloses these limitations:

an analog signal to optical converter that converts the analog signal to an optical level for coupling into an optical channel (Uyematsu, "intensity modulator," p. 582, middle of col. 2).

Regarding claim 38, claim 38 is an apparatus claim that corresponds to method claim 11. Therefore, the recited steps in method claim 11 read on the corresponding means in apparatus claim 38. Claim 38 also includes limitations absent from claim 11. Ling in view of any/all of Ungerboeck, Lee, and Schlegl and further in view of Uyematsu, and Winters discloses some of these limitations:

an optical source that receives the plurality of analog multilevel signals and produces a light output (Uyematsu, "intensity modulator" and corresponding light source for the modulator, p. 582, middle of col. 2) for driving an optical channel.

Ling in view of any/all of Ungerboeck, Lee, and Schlegl and further in view of Uyematsu, and Winters does not expressly disclose:

a plurality of data signals;

a plurality of equalizers; and

a plurality of equalized digital multilevel signals.

However, Examiner takes Official Notice that these "plurality" limitations are all part of an extremely well known practice of transmitting a time division multiplexed signal. At the time the invention was made, it would have been obvious to a person of ordinary skill in the art to implement these limitations in the method of Ling in view of any/all of Ungerboeck, Lee, and Schlegl and further in view of Uyematsu, and Winters. One of ordinary skill in the art would have been motivated to do this since transmitting a time division multiplexed signal is a common way to transmit multiple channels of data across a single optical communication line (fiber), thus increasing the number of users without requiring the installation of additional optical communication lines (fibers).

Regarding claim 42, claim 42 is an apparatus claim that corresponds largely to the method claim 11. Therefore, the recited steps in method claim 11 read on the corresponding means in apparatus claim 42. Claim 42 also includes limitations absent from claim 11. These limitations are:

a plurality of equalizers; and

a digital to analog converter that *sequentially* accepts the plurality of equalized digital multilevel signals and produces a plurality of *sequential* analog multilevel signals.

However, Examiner notes that the treatment of claim 11 incorporates a time division multiplexed signal. At the time the invention was made, it would have been obvious to a person of ordinary skill in the art to include these "plurality" and "sequential" limitations in the apparatus of Ling in view of any/all of Ungerboeck, Lee, and Schlegl and further in view of Uyematsu, and Winters. One of ordinary skill in the art would have been motivated to do this since time division multiplexing requires *sequential* treatment of *a plurality of* channels.

Regarding claim 57, claim 57 is a method claim that corresponds to method claim 28. Therefore, the recited steps in method claim 28 read on the corresponding steps in method claim 57.

Regarding claim 61, claim 61 is a method claim that corresponds largely to method claim 28. Therefore, the recited steps in method claim 28 read on the corresponding means in apparatus claim 61. Claim 61 also includes limitations absent from claim 28. Ling in view of any/all of Ungerboeck, Lee, and Schlegl and further in view of Uyematsu, and Winters discloses these limitations:

converting the data accepted from the optical channel to digital data (ADC 360 in Fig. 3); and

decoding the digital data accepted from the optical channel (portion after ADC 360).

Regarding claims 65 and 70, claims 65 and 70 are method claims that correspond to method claims 32 and 37, respectively. Therefore, the recited steps in method claims 32 and 37 read on the corresponding steps in method claims 65 and 70.

Regarding claim 71, claim 71 is a method claim that corresponds to apparatus claim 38. Therefore, the recited means in apparatus claim 38 read on the corresponding means in apparatus claim 71.

3. **Claims 5, 16, 31, 36, 41, 45, 60, 64, 69, and 74** are rejected under 35 U.S.C. 103(a) as being unpatentable over Ling in view of any/all of Ungerboeck, Lee, and Schlegl and further in view of Uyematsu, and Winters as applied to claims 2, 13, 30, 32, 39, 43, 59, 63, 66, and 72 above, and further in view of Fischer et al. ("Dynamics limited precoding, shaping, and blind equalization for fast digital transmission over twisted pair lines," hereinafter "Fischer").

Regarding claim 5, Ling in view of any/all of Ungerboeck, Lee, and Schlegl and further in view of Uyematsu, and Winters does not expressly disclose:

The method of claim 1 wherein the equalizing the digital multilevel symbols comprises precoding the digital multilevel symbols using a dynamic limiting precoder.

However, dynamics limiting precoders are known in the art. Fischer teaches such precoders (Fischer, Fig. 4). At the time the invention was made, it would have been obvious to a person of ordinary skill in the art to improve the Tomlinson Harashima precoder of Ling in view of any/all of Ungerboeck, Lee, and Schlegl and further in view of Uyematsu, and Winters by implementing the dynamics limiting precoder teachings of Fischer. One of ordinary skill in the art would have been motivated to do this since dynamics limiting precoding is a straightforward extension of Tomlinson Harashima precoding that provides the advantage of a lower dynamic range of the receiver input signal (Fischer, p. 1626, col. 1, last paragraph). When the dynamic range becomes very large, implementation of the system becomes complicated (Fischer, p. 1624, middle of col. 2).

Regarding claim 16, claim 16 is a method claim that corresponds to method claim 5. Therefore, the recited steps in method claim 5 read on the corresponding steps in method claim 16.

Regarding claim 31, claim 31 introduces a limitation that is addressed by Fischer (see treatment of claim 5 above). Similarly, Fischer is applied here to address the same limitation.

Regarding claim 36, claim 36 is an apparatus claim that corresponds to method claim 5. Therefore, the recited steps in method claim 5 read on the corresponding means in apparatus claim 36.

Regarding claims 41 and 45, claims 41 and 45 are apparatus claims that both correspond to method claim 16. Therefore, the recited steps in method claim 16 read on the corresponding means in apparatus claims 41 and 45.

Regarding claim 60, claim 60 is a method claim that corresponds to method claim 31. Therefore, the recited steps in method claim 31 read on the corresponding steps in method claim 60.

Regarding claim 64, claim 64 is a method claim that corresponds to method claim 31. Therefore, the recited steps in method claim 31 read on the corresponding steps in method claim 64.

Regarding claim 69, claim 69 is an apparatus claim that corresponds to method claim 36. Therefore, the recited steps in method claim 36 read on the corresponding means in apparatus claim 69.

Regarding claim 74, claim 74 is a method claim that corresponds to the apparatus claim 41. Therefore, the recited means in apparatus claim 41 read on the corresponding steps in method claim 74.

Response to Arguments

4. Applicant's arguments filed on 12 June 2007 have been fully considered but they are not persuasive. Applicant states,

> "[C]laim 1 includes performing Tomlinson-Harashima precoding in an optical transmission system. Applicant submits that this is not taught or suggested by the cited art. The only cited art that teaches Tomlinson-Harashima precoding is Ling, which is not directed to an optical transmission system. The only transmission medium referred to in Ling is copper (see page 4, last paragraph). Applicant submits that it would not have been obvious to one of ordinary skill in the art at the time that the invention was made to implement Tomlinson-Harashima precoding in an optical transmission system because optical transmission systems have different channel characteristics and present different challenges than copper cabling transmission systems. In the Office Action, the Examiner argues that it would be obvious to perform trellis coded modulation (TCM) in an optical transmission system, but fails to argue that it would be obvious to use Tomlinson-Harashima precoding in an optical transmission system" (REMARKS, p. 11).

Examiner respectfully notes that Applicant's arguments are not persuasive on at least two grounds.

First, the combination of the prior art of record *already* includes Tomlinson-Harashima precoding. That is, the standing rejection applies the teachings of Ling to an optical communication system. This application implies the inclusion of the Tomlinson-Harashima teachings of Ling in the combination of the prior art of record. It is unnecessary to provide an additional obviousness argument to incorporate teachings that are *already* included in the combination of the prior art of record. Accordingly, Applicant's arguments are not persuasive.

Second, even though optical transmission systems have different channel characteristics and present different challenges than copper cabling transmission systems, there are also similarities. Both are subject to the problem of intersymbol interference (ISI) (Ling, p. 1; Winters, p. 68-69, bridging

paragraph). Tomlinson-Harashima teachings help combat ISI (Ling, p. 4, l. 1-25). Therefore, one would be motivated to employ Tomlinson-Harashima teachings in an optical communication system environment to combat the similar problem of ISI. Moreover, notice that Winters teaches a variety of compensation techniques that are well known in electrical communication systems (Winters, Tables 1-5, compensation techniques). Then, notice that Winters teaches the application of these techniques in an optical communication system environment (Winters, Tables 1-5, impairments). In view of this overall trend in Winters, one could also reasonably expect benefits from other compensation techniques, well known in electrical communication systems, for optical communication systems. Such compensation techniques could include Tomlinson-Harashima teachings. Accordingly, Applicant's arguments are not persuasive.

Conclusion

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to David S. Kim whose telephone number is 571-272-3033. The examiner can normally be reached on Mon.-Fri. 9 AM to 5 PM (EST).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth N. Vanderpuye can be reached on 571-272-3078. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

DSK

KENNETH VANDERPUYE
SUPERVISORY PATENT EXAMINER